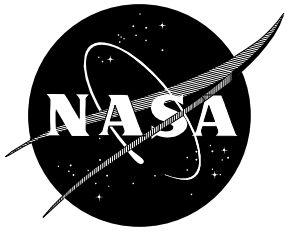
Integrated Experiment Hazard Assessment Generic Baseline

International Space Station Program

April 24, 2001

National Aeronautics and Space Administration
International Space Station Program
Lyndon B. Johnson Space Center
Houston, Texas



REVISION AND HISTORY PAGE

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ERU: M. Hehn 05/10/01

PREFACE

The Integrated Experiment Hazard Assessment (IEHA) Generic Baseline document has been developed to help ensure the safe on-orbit integration and operation of an International Space Station (ISS) payload complement and its interaction with ISS systems. The IEHA Generic Baseline document contains a list of hazards and hazard controls, considered to be applicable to the payload complement for every stage during ISS assembly and operation. This will ensure that a systematic approach for controlling on-orbit hazards is in place and verified. Each hazard control is supported with one or more verifications and verification organizations to ensure the cause is adequately controlled. The responsible verification organizations (RVOs) identified are required to perform each verification and to report the status of their verifications to the Boeing ISS Safety & Mission Assurance (S&MA) office. This verification information is included in the Boeing ISS S&MA and National Aeronautics and Space Administration (NASA) ISS S&MA Certificate of Flight Readiness reports.

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INTERNATIONAL SPACE STATION PROGRAM

INTEGRATED EXPERIMENT HAZARD ASSESSMENT GENERIC BASELINE

31 JANUARY 2001

CONCURRENCE

PREPARED BY:	M. P. Hudson	Boeing ISS S&MA
	PRINT NAME	ORGN
	/s/Michael P. Hudson	1/10/01
	SIGNATURE	DATE
SUPERVISED BY:	M. J. Massie	Boeing ISS S&MA
	PRINT NAME	ORGN
	/s/Michael J. Massie	1/10/01
	SIGNATURE	DATE
APPROVED BY:	M. G. Martin	Boeing ISS S&MA
	PRINT NAME	ORGN
	/s/M. G. Martin	1/10/01
	SIGNATURE	DATE
APPROVED BY:	D. W. Totton	NASA ISS S&MA
	PRINT NAME	ORGN
	/s/Donald w. Totton	1/10/01
	SIGNATURE	DATE
DQA:	Ann Wood	NASA DQA
	PRINT NAME	ORGN
	/s/Ann Wood	4/20/01
	SIGNATURE	DATE

INTEGRATED EXPERIMENT HAZARD ASSESSMENT GENERIC BASELINE APPROVAL SHEET

The signatures below signify concurrence with and approval of the on-orbit Integrated Experiment Hazard Assessment Generic Baseline process for ISS payloads. In addition, the undersigned organizations concur with the documentation of integrated experiment hazard control accountability and will provide the documents for hazard control verification status to Boeing ISS Safety and Mission Assurance as identified in Appendix E.

ORGANIZATION	MAIL CODE	RESPONSIBLE REPRESENTATIVE
Boeing ISS Electromagnetic Effects Analysis and Integration Team	HA1-20	/s/Kreg Rice K. L. Rice
Boeing ISS Environmental Control and Life Support Subsystem	HZ1-10	/s/Richard P. Reysa R. P. Reysa
Boeing ISS Environments Group	HA1-20	/s/Paul A. Boeder P. A. Boeder
Boeing ISS Payload Engineering and Integration	HS4-40	/s/Mo Saiidi M. Saiidi
JSC Mission Operations Directorate	DO-12	/s/Mark Childress J. M. Childress
JSC ISS Cargo Planning and Imagery	OC5	/s/Karen Schmalz K. Schmalz
JSC ISS Safety and Mission Assurance/Program Risk	OE	/s/James Wade for J. Holsomback
JSC ISS Payload Engineering and Integration	OZ3	/s/Daniel W. Hartman D. W. Hartman
JSC Space and Life Sciences Space Science Branch	SN3	/s/Michael J. Golightly M. J. Golightly
MSFC Flight Projects Directorate	FD32	/s/Rickey Cissom R. Cissom

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1.0 INTRODUCTION

1.1 PURPOSE

The IEHA is to satisfy the safety requirements of NSTS 1700.7B, ISS Addendum, "Safety Policy and Requirements for Payloads Using the International Space Station," paragraph 102.2, and to show compliance with SSP 50200-01, "Station Program Implementation Plan, Volume 1: Station Program Management Plan" for an integrated hazard analysis.

The National Aeronautics and Space Administration (NASA) ISS S&MA Office is the controlling authority for the processes and reports in this document.

The Boeing ISS S&MA Office is under contract to develop the IEHA process, IEHA Generic Baseline document, and IEHA reports via Space Station Change Memo 438, "Engineering Integration and Payload Software Verification (PSIV)."

The purpose of this document is to:

1) Identify generic, on-orbit, payload complement hazards,
2) Identify the organization best suited for verifying the hazards are controlled,
3) Assure NASA and Boeing ISS S&MA Offices that the hazards are controlled, and
4) Document the reporting process for generic, on-orbit payload complement hazards.

Additionally, this document outlines the process for identifying any unique payload complement hazards and how they are reported to the NASA and Boeing ISS S&MA Offices.

To ensure that the assessment identifies and controls hazards for the entire on-orbit ISS payload complement, the International Partners (IP) shall use SSP 50417 IP Addendum for reporting IEHA hazards to the Boeing ISS S&MA Office.

The generic hazard reports contained in this document, plus the generic hazards identified in SSP 50417, IP Addendum, plus any unique payload complement hazards shall be reported to the Payload Safety Review Panel (PSRP) by the Boeing ISS S&MA Office for approval. The PSRP-approved IEHA report supports both the NASA and Boeing ISS S&MA Certificate of Flight Readiness (CoFR) statements. See Figures 1-1 and 1-2.

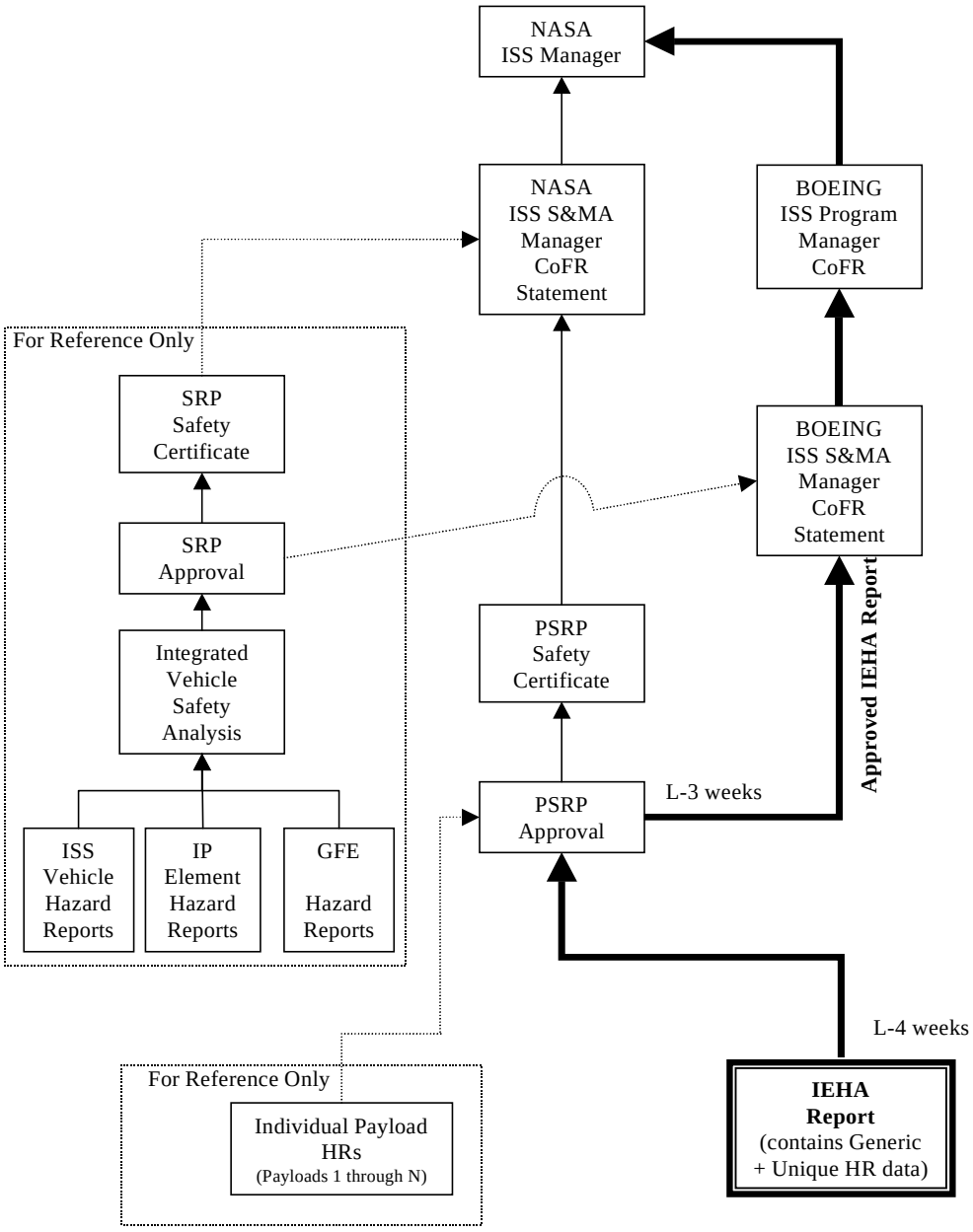
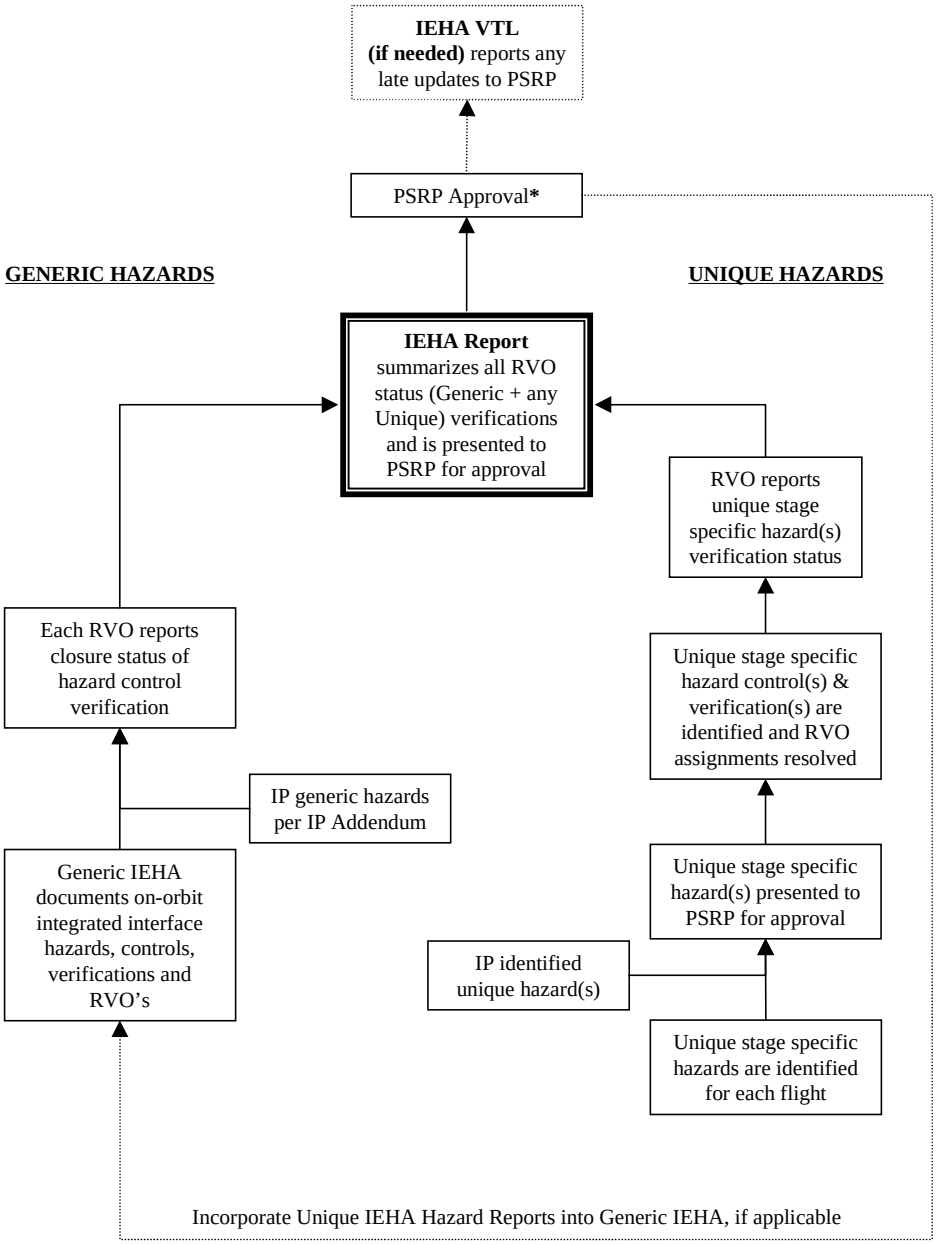


FIGURE 1-1. IEHA CoFR reporting



* PSRP membership includes International Partner representation

FIGURE 1-2. IEHA report development process

1.2 SCOPE

The IEHA Generic Baseline document establishes a set of generic on-orbit hazards against which the ISS payload complement will be assessed. The payload complement is defined as the entire group of payloads (scientific experiments) stowed aboard, attached to, or to be operated on the ISS at a specific point in time. The set of generic hazard reports contained herein will be used to help determine the risk to ISS systems (including software) and crew activities associated with the integration and/or operation of on-orbit ISS payloads.

The IEHA report is an assessment based upon the manifested hardware and its associated operations for each stage. A stage is defined as the time period from ISS-shuttle launch to ISS-shuttle launch and includes all ISS-IP launches in between. Changes to the payload complement created by payloads launched on IP vehicles will be assessed on the preceding ISS-shuttle mission. Each IP is responsible for providing the payload manifest and associated safety data packages for their respective ISS module to the PSRP. Figure 1-3 illustrates which flights are included in a stage and where each stage is reported. The PSRP provides the safety approval for all ISS payloads. The IEHA process will provide an assessment to the PSRP for late changes to the manifest and/or unscheduled hardware up to Flight Readiness Review (FRR). Between FRR and launch and during mission operations, Mission Operations Directorate (MOD) and the Mission Management Team will address late changes.

Example IEHA Report Delivery Schedule
Based on the Assembly Sequence Rev. F

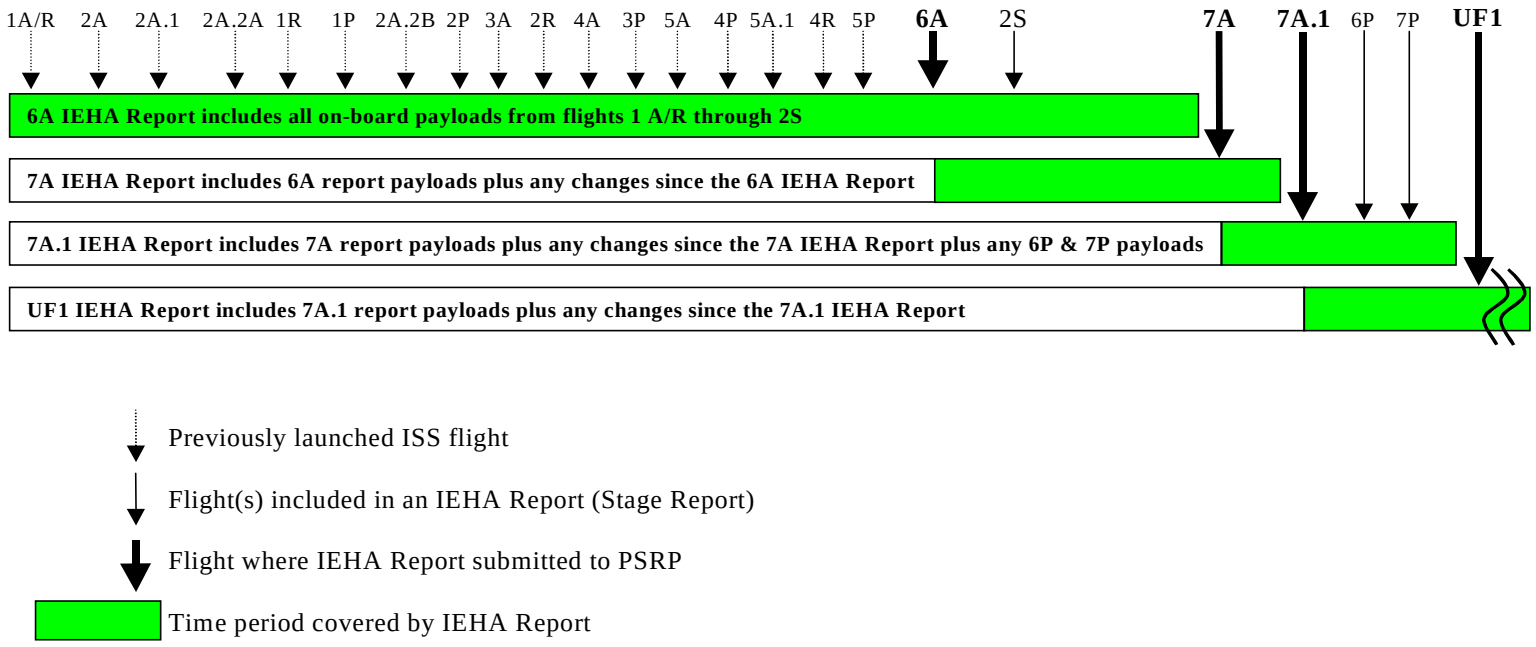


FIGURE 1-3. ISS flights contained in an IEHA report

1.3 BACKGROUND

All Payload Developers provide flight safety data packages for review and approval through the PSRP. Each safety data package addresses hazards associated with an individual payload. An Integrated Cargo Hazard Assessment (ICHA) is performed per the Generic Integrated Cargo Hazard Assessment Report (GICHAR) process for each Shuttle flight. The flight specific ICHA report provides a document that verifies Shuttle (flight and ground) hazard control implementation for the integrated payload hazards.

Similarly, the IEHA Generic Baseline document defines the process by which closure of hazard control verifications associated with the on-orbit ISS integrated payload complement interface are performed and documented. The completion of the IEHA process will be documented as part of the Boeing ISS S&MA CoFR.

The IEHA stage report performs a safety assessment of on-orbit hazards associated with the following:

a. Activity that begins after the entire ISS payload complement is installed/stowed/attached internally or externally to an ISS element,
b. The on-orbit installation and checkout of an ISS payload into a rack,
c. The integrated payload complements' interaction with the ISS vehicle,
d. The interaction between different payloads, and
e. The translation of ISS payloads to and within the ISS.

The IEHA stage report does not perform a safety assessment for the following (these areas are covered by other assessments – see Note):

f. The transportation phase of flight (i.e. pre-launch, launch, ascent, non-ISS on-orbit operations, entry, and landing),
g. ISS system (non-payload) rack integration or operation,
h. Pre-defined removal, translation, or installation of ISS element racks/equipment into an element,
i. Individual payload rack removal from carrier, translation to and installation into initial ISS location, and
j. Installation of returning payload into the Multi-Purpose Logistics Module (MPLM) or other cargo carrier.

Note: The NSTS 21111 “Generic Integrated Cargo Hazard Assessment Report” and (unnumbered) Generic Integrated Cargo Item and Carrier Hazard Assessment Report (GICICHAR) processes cover item “f.” The Boeing ISS vehicle safety assessment process performs the safety analysis on items "g." and "h." Item "i." is performed by the individual payload safety analysis. Item “j.” is the responsibility of the appropriate payload carrier integrator, (e.g., Marshall Space Flight Center (MSFC) for the MPLM and Spacehab for the Integrated Cargo Carrier (ICC)).

Table 1-1 outlines the "hand-over" points at which the stage specific IEHA report is initiated or terminated for payloads being transferred to or from the ISS.

TABLE 1-1. IEHA hand-over points

Payload Cargo Item Transfer		On-orbit IEHA Hand-over
SRMS	To ISS	Release of the SRMS End Effector (EE) from the payload after capture of the payload by the ISS retaining mechanism(s)
	To ISS	Release of the SRMS EE after having the payload co-grappled by the ISS SSRMS at the common SRMS/SSRMS "capture" point
	To ISS EVA Crew	Release of the SRMS EE from the payload after grapple of the payload by the EVA crew
	From ISS	Release of the payload from the ISS retaining mechanism(s) after having been grappled by the SRMS
	From ISS	Release of the SSRMS EE after having the payload co-grappled by the SRMS at the common SRMS/SSRMS "capture" point
	From ISS EVA Crew	Release of the payload from the EVA crew after payload grapple by the SRMS EE
ISS SSRMS	To ISS	Release of the payload from the Shuttle payload bay latches (PRLAs) after having been grappled by the SSRMS
	To ISS	Release of the SRMS EE at the common SRMS/SSRMS "capture" point after having the payload co-grappled by the SSRMS
	To ISS EVA Crew	Release of the payload from the Shuttle PRLAs after grapple by the SSRMS
	From ISS	Release of the SSRMS EE from the payload after PRLA capture of the payload in the Shuttle payload bay
	From ISS	Release of the SSRMS EE at the common SRMS/SSRMS "capture" point after having the payload co-grappled by the SRMS
	From ISS EVA Crew	Release of the SRMS EE from the payload after PRLA capture of the payload in the Shuttle payload bay
Shuttle EVA	To ISS Crew	Release of the payload by the Shuttle EVA crew after grapple of the payload by the ISS EVA crew
	From ISS EVA Crew	Release of an external ISS cargo item by an EVA crew member for placement and return in the Shuttle cargo bay
IVA Crew	To ISS	Initiated at the ISS hatch interface for payloads being transferred internally from the Shuttle to the ISS
	From ISS	Initiated at the ISS hatch interface for payloads being transferred internally from the ISS to the Shuttle

NOTE: "To ISS" indicates the initiation of an IEHA assessment. "From ISS" indicates the termination of an IEHA assessment.

1.4 REPORT PROCESS OVERVIEW

For each stage, an IEHA Report is created using inputs received from the RVOs for both generic and stage-unique hazards. For the generic hazards, the RVOs develop an internal process to verify closure of hazard controls. When an RVO finishes the verification tasks, it reports the status to the Boeing ISS S&MA Office for incorporation into the IEHA stage report. The generic IEHA hazards listed in Section 4 identify the generic hazards, hazard controls, verification tasks, and the RVO.

For unique hazards the process is not as simple. First a unique integrated payload complement hazard must be identified. Any organization may identify a unique hazard. The unique hazard, with its associated hazard controls, verification tasks and RVO, identified, will be presented to the PSRP for approval. After PSRP approval, the RVO will perform the required verification tasks and report the status to the Boeing ISS S&MA Office for incorporation into the IEHA stage report.

The IEHA Report (otherwise known as the IEHA Stage Report) is sent to the PSRP at Launch minus 4 weeks (L-4 weeks) for approval. An IEHA Verification Tracking Log (VTL) is created by Boeing only to report any last minute changes and/or any RVO whose verification status was not included in the stage report.

1.5 LIMITATIONS

Acoustic and Electromagnetic Interference (EMI) hazard assessments are performed on a per module basis. Additionally, the NASA reports only on the payload complement in or on the United States segment. Likewise, the IPs report only on the payload complement in or on their respective segment.

2.0 DOCUMENTATION

2.1 APPLICABLE DOCUMENTS

Below is a list of documents applicable to this report. When referencing these documents, the current revision should be used.

Document No.	Title
NSTS 1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System
NSTS 1700.7B ISS Addendum	Safety Policy and Requirements for Payloads Using the International Space Station
NSTS/ISS 13830	Payload Safety Review and Data Submittal Requirements for Payloads Using the Space Shuttle and International Space Station
NSTS/ISS 18798	Interpretations of NSTS/ISS Payload Safety Requirements
SSP 50021	Safety Requirements Document: International Space Station
SSP 50200-01	Station Program Implementation Plan, Volume 1: Station Program Management Plan
SSP 50417 IP Addendum	Integrated Experiment Hazard Assessment
SSP 5410X - Y	Increment Definition and Requirements Document for Planning Period X, Annex 1: Station Manifest, Flight Y, STS-nnn
SSP 57000	Pressurized Payloads Interface Requirements Document
SSP 57003	Attached Payload Interface Requirements Document

2.2 REFERENCE DOCUMENTS

Below is a list of reference documents applicable to this report.

Document No.	Title
NSTS 21111	Space Shuttle Generic Integrated Cargo Hazard Assessment Report
SSP 41000	System Specifications for the International Space Station
SSP 41162	Segment Specification for the United States On-Orbit Segment
(unnumbered)	Generic Integrated Cargo Item and Carrier Hazard Assessment Report

3.0 HAZARD ASSESSMENT PROCESS

This document provides a set of generic or "standard" hazards associated with the integration of payloads in and onto the ISS and their interactions with each other and describes the process by which the completion of verification tasks is reported to ISS Program management. It also specifies the process by which unique payload-complement hazards, if any, are identified and reported to ISS Program management. The IEHA hazard assessment process addresses both the generic and flight specific hazards. SSP 50417, IEHA Generic Baseline and SSP 50417, IP Addendum addresses the generic hazards that are expected for each stage.

An IEHA hazard report addresses both generic and any unique payload integrated interface hazards between payload complement-to-ISS and payload-to-payload. This IEHA report will identify unique integrated hazards, their controls, verifications, and RVOs. It will also address those hazards not specifically covered by the set of generic IEHA baselined hazards. Identification of the unique hazards will be pre-coordinated with Boeing/JSC ISS Payload Engineering and Integration; Boeing/JSC Mission Operations; MSFC Payload Operations Integration Center (POIC), JSC ISS S&MA; and any other appropriate organizations as shown in Figure 3-1. Should a unique hazard be identified, the hazard control will probably be an operational control as opposed to a design change to a payload item. An example of an operational control would be "do not operate experiment A and experiment B simultaneously."

3.1 FLIGHT MANIFEST

The official ISS manifest is maintained by the Manifest Working Group (MWG) and is documented in the Increment Definition and Requirements Document (IDRD), Annex 1. The SSP number is SSP 5410X-FLT, where X represents the planning period and FLT represents the ISS flight. For example, the Flight 6A IDRD, Annex 1 is numbered: SSP 54102-06A. The web site for the MWG is:

http://iss-www.jsc.nasa.gov/ss/issapt/mio/mwg/IDRDpage.htm

All RVOs shall use this site to obtain the latest payload manifest. As the manifest is dynamic, RVOs are requested to check the manifest beginning at L-7 months and continue to check it all the way to the Flight Readiness Review (FRR) which occurs at approximately L-2 weeks.

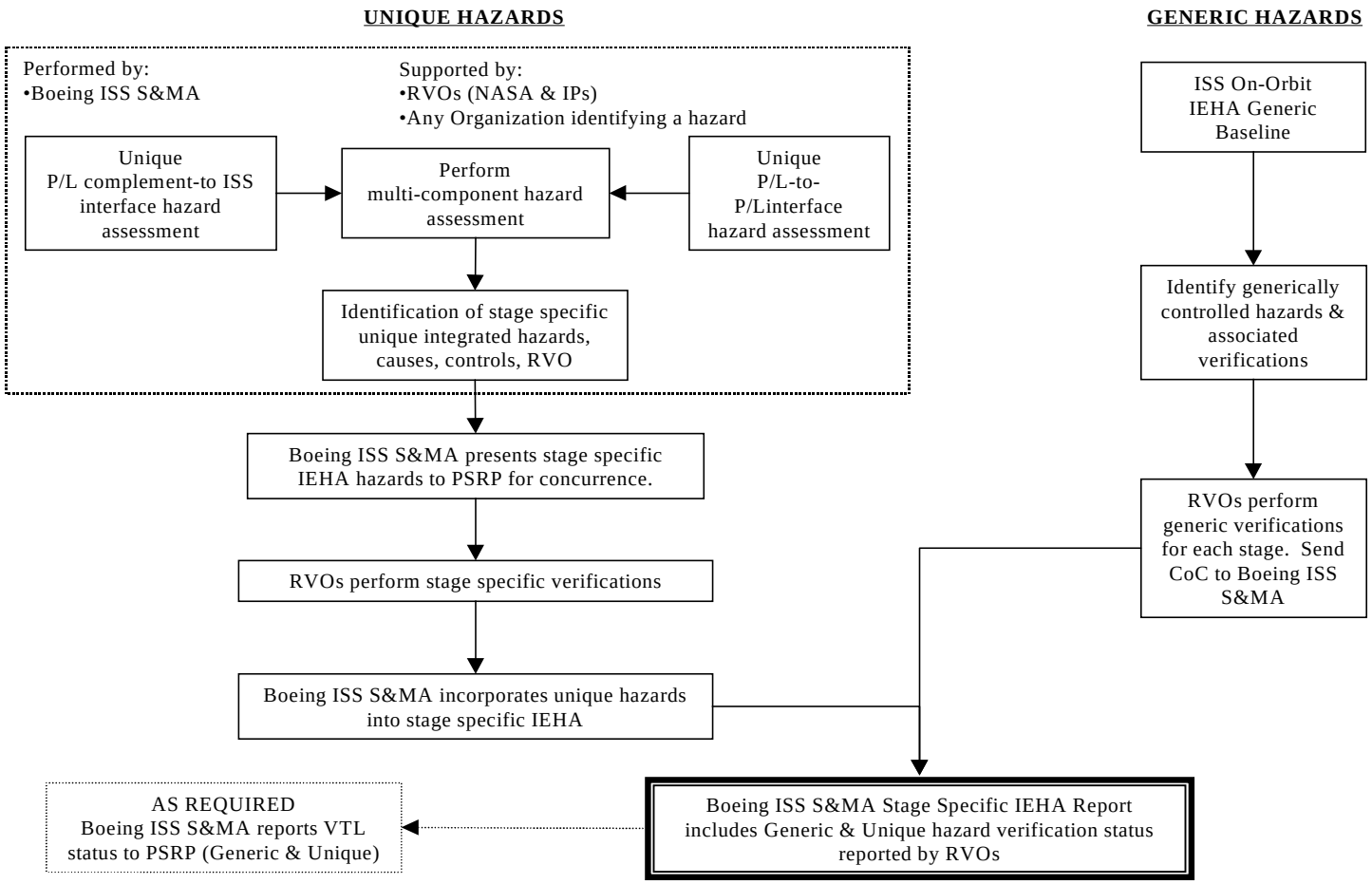


FIGURE 3-1. Hazard assessment process flow

3.2 REPORT DEVELOPMENT PROCESS

Pre-coordinated NASA-reported IEHA generic hazards, IP-reported IEHA IP Addendum generic hazards plus any (NASA and IP) stage unique payload complement hazards, will be presented to the PSRP for concurrence and approval. The results will be reported and documented via the IEHA Report and the Boeing ISS S&MA CoFR process. The PSRP-approved IEHA report is included in the Boeing ISS S&MA CoFR. The IEHA Report is delivered to the PSRP Executive Secretary by L-3 weeks. The IEHA Report will contain (A) an Executive Summary, (B) Payload Topology, (C) List of payloads assessed, (D) Reported RVO Certificates of Completion (CoCs), (E) Open RVO verifications, and (F) any unique hazard reports generated for the assessment. A Verification Tracking Log (VTL) will be created on an "as required" basis to close any RVO verification that was not reported in the IEHA Report. Appendix C contains a sample IEHA Report and VTL.

Table 3-1 summarizes the activities and gives a timeline for the IEHA Report development process for both unique and generic hazards. Starting at L-7 months, the NASA ISS S&MA Office will send out a letter containing the manifest for the upcoming IEHA Report. The RVOs will check the payload manifest and start verification task data collection. Since the payload manifest may change several times, all parties, especially the RVOs, should check the MWG website periodically for any changes that may affect verification analysis (see Section 3.1).

At L-6 weeks (30 working days, per the NASA working calendar) it is expected that the majority of RVOs have completed their generic verification tasks and any associated analysis, as well as any unique hazard verification and analysis identified by this time. Paragraph 3.2.1 describes generic hazard reporting and Paragraph 3.2.2 describes unique hazard reporting. Boeing ISS S&MA requests that the RVOs submit their CoCs as described in this document.

At L-5 weeks (25 working days), all verification information, for both generic and unique hazards, received from the RVOs will be included into the IEHA Report. Boeing ISS S&MA will have 5 working days to complete the IEHA Report and submit it to the PSRP Executive Secretary. The IEHA Report is submitted electronically and via hardcopy to the PSRP Executive Secretary by close of the business day of L-4 weeks. The PSRP will have 5 days to review and disposition (approve) the IEHA Report. The IEHA Report summarizes the information reported by the RVOs via their CoCs.

Any information reported by any RVO after the L-5 week deadline shall be reported as a VTL closure item. Appendix C contains a sample IEHA Report and a sample VTL report.

TABLE 3-1. Generic IEHA report development timeline

Launch minus time	Organization	Action
L-7 months See Note (1)*	NASA S&MA	1. Send out initial IEHA payload manifest letter.
	RVOs (i.e., IPs, MOD, PEI, POIC, & SN3, etc.)	1. Start verification status data collection.
	Boeing ISS S&MA	1. Verify manifest with PSRP.
L-6 months*	RVOs	1. Check payload manifest. 2. Identify any Unique Hazards. Establish hazard verifications. Report to Boeing ISS S&MA, if applicable.
	Boeing ISS S&MA	1. Start IEHA Report.
L-4 months*	RVOs	1. Verify payload manifest. 2. Incorporate any changes caused by manifest changes into internal RVO IEHA HR analysis.
L-3 months*	RVOs	1. Verify payload manifest. 2. Incorporate any changes caused by manifest changes into internal RVO IEHA HR analysis.
L-6 weeks* Pre-PRR	RVOs	1. Submit Certificate of Completion for all Generic IEHA verification tasks to Boeing ISS S&MA. 2. Submit Certificate of Completion for all Unique IEHA verification tasks to Boeing ISS S&MA.
	Boeing ISS S&MA	1. Update IEHA Report.
L-5 weeks*	RVOs	1. Last chance to submit CoC for incorporation into IEHA Report. Unsubmitted CoCs to be closed via VTL
L-4	Boeing	1. Submit IEHA Report to PSRP Executive Secretary for PSRP approval.
L-3 weeks	PSRP	1. Approve IEHA Report.
Post IEHA Report submittal and pre-FRR	Boeing ISS S&MA	1. Submit VTL closures (if required) to PSRP.

*Note (1): Anytime a unique HR is identified, Boeing will establish the proposed HR, Hazard Controls, Verification Tasks and RVO and submit to PSRP for approval.

3.2.1 GENERIC HAZARD REPORTING

Integrated payload complement hazards have been categorized as either “generic” or “unique.” Borrowing “lessons learned” from the Space Shuttle program, generic hazards, with associated hazard controls and verification tasks have been identified to ensure the majority of expected integrated payload complement hazards are controlled. Each RVO identified in the generic hazard reports is expected to perform the assigned verification tasks as part of the normal work that the particular RVO performs for each stage. Each RVO has an internal process or processes to identify and capture the details of who, when and where each verification task is performed. To simplify the verification task completion reporting process, each RVO shall submit a CoC as described in Section 3.3.

NASA ISS S&MA reserves the right to audit the RVO internal processes for identifying and verifying that the verification tasks are performed.

3.2.2 UNIQUE HAZARD REPORTING

For any unique integrated payload complement hazard identified, a hazard report complete with a hazard description, hazard controls, verification tasks and an RVO will be written by Boeing ISS S&MA. Boeing has the responsibility to identify potential unique hazards, however, any organization may identify a unique hazard and work with Boeing to accurately capture the unique hazard report. It is important to identify any unique hazard as early as possible to allow the unique hazard RVO enough time to perform the verification tasks. As soon as a unique hazard is identified, Boeing will submit it to the PSRP for approval. Upon PSRP approval the identified RVO shall perform the unique hazard verification tasks and report completion of the verification tasks to Boeing ISS S&MA via a CoC for the unique hazard.

NASA ISS S&MA reserves the right to audit the RVO internal processes for identifying and verifying that the verification tasks are performed.

3.3 CERTIFICATE OF COMPLETION

The CoC reports the completion of all verification tasks assigned and a summary of the results. The CoC may be a copy of the CoFR statement the RVO uses to report to ISS Program Management or other documentation the Boeing ISS S&MA organization approves as acceptable. It is expected that all RVOs submit their CoC by the Payload Readiness Review (PRR) nominally scheduled at Launch minus 6 weeks (L-6 weeks).

The following is an example of an acceptable CoC:

The Boeing Payload Engineering and Integration (PEI) organization has completed the integrated experiment hazard analysis on the ISS Flight 7A.1 payload manifest dated May 1, 2001. This manifest includes payload items identified in Flights 6P and 7P. All RVO tasks assigned to OZ3/PEI have been successfully completed except for IEHA HR-003, verification task 2.1.2, Document constraints to ensure adequate payload restrictions. PEI analysis is that all IEHA

generic hazards are adequately controlled and verified. The estimated completion date for task 2.1.2 is May 15, 2001. The completion of 2.1.2 will not affect the PEI analysis.

Signed by: Mr. M. Saiidi, Boeing, Manager Payload Engineering & Integration, MM/DD/YYYY.

The RVO demonstrates completion of their tasks by sending a CoC letter to:

Boeing ISS S&MA
Attention: IEHA
Mail code HS1-30
2100 Space Park Drive
Houston, TX 77058

Alternatively, the RVO may submit the CoC electronically, in Microsoft Word 2000 compatible format, to michael.hudson@sw.boeing.com.

3.4 HAZARD ASSESSMENT AND VERIFICATION ACCOUNTABILITY

The organization of prime responsibility for this process is Boeing ISS S&MA.

Each RVO will report closure of verifications to Boeing ISS S&MA. For each IEHA Report (IEHA Stage Report), Boeing ISS S&MA shall maintain a VTL to document the completion of verification task activities by RVOs identified in the generic hazard reports listed in Appendix D. The IEHA Stage Report also includes the IP verification tasks identified in SSP 50417 IP Addendum plus any RVO verification task identified in any stage unique integrated payload complement hazard report.

3.5 IEHA PROCESS OVERSIGHT

All organizations (NASA, IP and contractors) are responsible for safety and may identify new integrated hazards. The Boeing ISS S&MA organization will perform an independent assessment of each stage to identify if any stage unique hazards exist, which fall outside of the scope of the generic hazards identified herein. This review will be accomplished for each stage and any new unique hazards will be documented and presented to the PSRP for approval as part of the IEHA Stage Report.

3.6 HAZARD ASSESSMENT PROCESS AUDIT

NASA ISS S&MA/Program Risk (NASA mail code OE) reserves the right to perform audits of the organizations responsible for hazard control verifications to assure the rigor of evaluation as required by the PSRP and to ensure that the integrity of the CoFR process is being maintained.

3.7 DOCUMENT CHANGE CONTROL PROCESS

Changes to this document shall be made through, and controlled by, the JSC NASA Document Quality Assurance (DQA) processes.

4.0 INTEGRATED EXPERIMENT HAZARD ASSESSMENT HAZARD REPORTS

This assessment addresses generic on-orbit hazards associated with the ISS payload complement. Table 4-1 lists the integrated hazard reports identified in this document.

TABLE 4-1. On-Orbit IEHA hazard report list

HR Number	Hazard Report Title
IEHA-001	**Premature/Inadvertent Payload Operations**
**IEHA-002*	*Incompatible/Corrosive/Flammable Materials (Reserved)*
IEHA-003	**Payload Complement Degrades Critical ISS Function(s)**
IEHA-004	**Excessive Ionizing Radiation**
**IEHA-005*	*Excessive Non-Ionizing Radiation (Reserved)*
IEHA-006	**EMI/EMC**
**IEHA-007*	*Structural Damage/Failure (Reserved)*
**IEHA-008*	*External Collision/Contact Hazards (Reserved)*
IEHA-009	**Hazardous EVA Operations Associated with External ISS Experiments**
**IEHA-010*	*Cumulative Effects of Thermal Extremes (Reserved)*
IEHA-011	**Nominal Operational Incompatibility**
**IEHA-012*	*Structural Damage to Payloads (Reserved)*
**IEHA-013*	*Safety Critical Functions Fail to Operate (Reserved)*
IEHA-014	**IVA/Internal Operations**
IEHA-015	**Rapid Safing**
IEHA-016	**Hazardous Accumulation of Acoustic Noise**
IEHA-017	**Inadequate/Inappropriate Stowage**

***Note:** These hazards have been assessed and are considered not applicable to this revision. The hazards (if applicable) will be assessed in the stage specific IEHA. The hazard report numbers have been reserved for future updates.

4.1 ON-ORBIT IEHA HAZARD REPORT SUMMARY

A summary of the integrated hazard reports is provided below. The detailed integrated hazard reports with causes, controls and verifications are provided in Appendix D.

4.1.1 IEHA-001 – PREMATURE/INADVERTENT PAYLOAD OPERATIONS

This hazard addresses premature/inadvertent payload operations resulting in a hazardous condition. ISS payloads are designed to be safe without services.

4.1.2 IEHA-002 – INCOMPATIBLE/CORROSIVE/FLAMMABLE MATERIAL (RESERVED)

4.1.3 IEHA-003 – PAYLOAD COMPLEMENT DEGRADES CRITICAL ISS FUNCTION(S)

This hazard addresses the cumulative power and/or thermal and/or chemical usage or failures associated with an ISS payload complement that degrades these critical ISS functions during on-orbit operations. Cumulative power and/or thermal and/or chemical usage of the payload complement will not create a hazardous condition to ISS power, thermal or Environmental Control and Life Support (ECLS) systems under worst case conditions.

4.1.4 IEHA-004 – EXCESSIVE IONIZING RADIATION

This hazard addresses the cumulative effects of ionizing (radioactive) radiation caused by the on-orbit payload complement /integrated racks that could induce hazardous effects on the crew, ISS and/or the payload complement. The cumulative ionizing radiation levels are limited to prevent a hazardous condition to the payload complement/ISS/crew.

4.1.5 IEHA-005 – EXCESSIVE NON-IONIZING RADIATION (RESERVED)

4.1.6 IEHA-006 – EMI/EMC

This hazard addresses potentially hazardous effects on critical ISS and/or the payload complement/integrated rack avionics/circuitry caused by excessive effects of radiated and/or conducted electromagnetic emissions. Allowable radiated and/or conducted emissions of the payload complement are compatible with the ISS susceptibility thresholds and the crew.

4.1.7 IEHA-007 – STRUCTURAL DAMAGE/FAILURE (RESERVED)

4.1.8 IEHA-008 – EXTERNAL COLLISION/CONTACT HAZARDS (RESERVED)

4.1.9 IEHA-009 – HAZARDOUS EVA OPERATIONS ASSOCIATED WITH EXTERNAL ISS EXPERIMENTS

This hazard addresses extravehicular hazardous operations. The EVA safety requirements include requirements for (1) touch temperatures, (2) equipment handling, (3) levers, cranks, hooks, and controls, (4) translation paths and worksites, (5) structural limits, (6) quick disconnects, and (7) any payload hazards outside the crew habitable area.

4.1.10 IEHA-010 – CUMULATIVE EFFECTS OF THERMAL EXTREMES (RESERVED)

ISS Thermal Control System is addressed in IEHA-003, EVA temperatures are addressed in IEHA-009 and IVA temperatures are addressed in IEHA-014.

4.1.11 IEHA-011 – NOMINAL OPERATIONAL INCOMPATIBILITY

This hazard addresses nominal operational incompatibilities between different payload complements and/or the ISS. Manifesting and placement of payloads is pre-coordinated to ensure their respective operations are compatible with the ISS, the crew, and other payloads

4.1.12 IEHA-012 – STRUCTURAL DAMAGE TO PAYLOADS (RESERVED)

4.1.13 IEHA-013 – SAFETY CRITICAL FUNCTIONS FAIL TO OPERATE (RESERVED)

4.1.14 IEHA-014 – IVA/INTERNAL OPERATIONS

This hazard addresses the following IVA internal operations: impact during translation/installation of an payload complement; valid command issued erroneously to incorrect payload; and pinch points caused by operational activity between two different payloads/racks. Manifesting and placement of payloads is pre-coordinated to ensure their respective operations are compatible with the ISS, the crew, and other payloads.

4.1.15 IEHA-015 – RAPID SAFING

This hazard addresses the inability to egress to an adjacent module and close the hatch. Manifesting and placement of payloads is pre-coordinated to ensure their respective operations are compatible with the ISS, the crew, and other payloads.

4.1.16 IEHA-016 – HAZARDOUS ACCUMULATION OF ACOUSTIC NOISE

This hazard addresses the on-orbit crew exposure to excessive noise caused by the cumulative acoustical emissions of multiple experiment operations within a module. Manifesting and placement of payloads is pre-coordinated to ensure cumulative noise levels are compatible with the ISS noise requirements and do not pose a hazard to the crew.

4.1.17 IEHA-017 – INADEQUATE/INAPPROPRIATE STOWAGE

This hazard addresses the following on-orbit stowage hazards: inadequate/inappropriate stowage provisions resulting in emergency egress being impeded; and inadequate stowage provisions resulting in improperly stowed equipment impeding the crew's ability to access emergency equipment. Payloads are designed to include adequate stowage for their waste and hardware. Boeing ISS hazard report ISS-STO-801, Injury of Crew or Damage to ISS during Transfer and Stowage of Loose Hardware addresses stowage hazards more thoroughly as it accounts for all stowed items, vehicle hardware, GFE, and payloads. It includes causes for the following items. (1) Stowed hardware interferes with operation of critical systems. (2) Stowed hardware interferes with the ability to egress and isolate a module within 3 minutes. (3) Injury to crew during translation of manifested logistics and payloads, and (4) Hardware stowage configuration exceeds physical limitations of interfering hardware and/or presents hazard to crewmember.

Appendix D contains the IEHA generic baseline hazard reports.

APPENDIX A – ACRONYMS AND ABBREVIATIONS

AIT	Analysis and Integration Team
C&DH	Command & Data Handling
CoC	Certificate of Completion
CoFR	Certificate of Flight Readiness
Cont.	Continued
CR	Change Request
DO	Mail code for JSC Mission Operations Directorate
DQA	Document Quality Assurance
EE	End Effector
EMC	Electromagnetic Compatibility
EME	Electromagnetic Effects
EMI	Electromagnetic Interference
EMU	Extravehicular Maneuvering/Mobility unit
ESA	European Space Agency
EVA	Extravehicular Activity
FRR	Flight Readiness Review
GICHAR	Generic Integrated Cargo Hazard Assessment Report
GICICHAR	Generic Integrated Cargo Item and Carrier Hazard Assessment Report
HR	Hazard Report
ICC	Integrated Cargo Carrier
ICD	Interface Control Document
ICHA	Integrated Cargo Hazard Assessment
IDD	Interface Definition Document
IDRD	Increment Definition and Requirements Document
IEHA	Integrated Experiment Hazard Assessment
IFM	In-Flight Maintenance
IP	International Partners
IRD	Interface Requirements Document
ISPR	International Standard Payload Rack
ISS	International Space Station
IVA	Intravehicular Activity
JSC	Johnson Space Center
L-	Launch minus
MOD	Mission Operations Directorate
MPLM	Multi-Purpose Logistics Module

MSFC	Marshall Space Flight Center
MWG	Manifest Working Group
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency (Japanese Space Agency)
NSTS	National Space Transportation System
NSTS/ISS	National Space Transportation System and/or International Space Station
OC5	Mail code for JSC ISS Cargo Planning and Imagery
ODS	Orbiter Docking System
OE	Mail code for JSC ISS Safety & Mission Assurance Office
OZ	Mail code for JSC ISS Payloads Office
OZ3	Mail code for JSC ISS Payload Engineering and Integration Office
PEI	Payload Engineering and Integration
PLB	Payload Bay
PM	Program Manager
POHD	Payload Operations Hazard Document
POIC	Payload Operations Integration Center
PRLA	Payload Retention Latch Assembly
PRR	Payload Readiness Review
PSRP	Payload Safety Review Panel
RASA	Russian Aviation and Space Agency
Rep.	Representative
Rpt.	Report
RVO	Responsible Verification Organization
S&MA	Safety & Mission Assurance
SAFER	Simplified Aid For Emergency Rescue
SD	Mail Code for JSC Medical Branch
SN3	Mail code for JSC Life Sciences, Space Science Branch
SRMS	Shuttle Remote Manipulator System
SRP	Safety Review Panel
SSP	Space Station Program
SSRMS	Space Station Remote Manipulator System
STS	Space Transportation System
TBD	To Be Determined
TBO	To Be Obtained
TBS	To Be Supplied
VTL	Verification Tracking Log

APPENDIX B – GLOSSARY

Catastrophic Hazard	A hazard which can result in the potential for a disabling or fatal personal injury or loss of the ISS.
Certificate of Completion	A document written and signed by a RVO, stating that the RVO has completed all verification tasks assigned to them. Examples of acceptable CoCs include: A) a document that details the status of each and every verification task, B) a copy of the CoFR statement submitted by the RVO, C) a copy of the signed hazard report which verifies the work has been completed.
Critical Hazard	A hazard which can result in damage to ISS equipment, a nondisabling personnel injury, or the use of unscheduled safing procedures that affect operations of the ISS Orbiter or another payload.
Generic Hazard	A hazard that has been determined to have the potential for occurring during every stage and must be assessed for every IEHA report.
Hazard	The presence of a potential risk situation caused by an unsafe act or condition. A condition or changing set of circumstances that presents a potential for adverse or harmful consequences; or the inherent characteristics of any activity, condition or circumstances, which can produce adverse or harmful consequences.
Hazardous Command	A command that can create an unsafe or hazardous condition which potentially endangers the crew or station safety. It is a command whose execution can lead to an identified hazard or a command whose execution con lead to a reduction in the control of a hazard.
IEHA Report	The report submitted by Boeing ISS S&MA to the PSRP summarizing the RVO analysis and any effects of both the generic and any unique payload complement integrated hazards.
IEHA VTL	The report submitted by Boeing ISS S&MA to the PSRP after IEHA Report has been submitted and summarizes any changes to the IEHA Report.
Launch Interval	The time period from one ISS-shuttle launch-to-ISS-shuttle launch and includes all ISS IP launches in between. Also referred to as “stage” in this report.
Payload	An individual ISS scientific experiment.
Payload Complement	The entire group of payloads (scientific experiments) stowed aboard, attached to, or to be operated on the ISS at a specific point in time.

	attached to, or to be operated on the ISS at a specific point in time.
Payload Operating Procedures	Procedures developed for the safe operation of the payload according to pre-established requirements, other system procedures, Flight Rules and training.
Stage	See Launch Interval
Unique Hazard	An unique payload-complement hazard for the ISS payload complement not previously identified in the generic hazard reports

APPENDIX C – SAMPLE IEHA REPORT

SSP 50417 On-orbit Integrated Experiment Hazard Assessment Report For

ISS Mission 4A (STS-97)

Prepared By:

Michael P. Hudson
Boeing ISS Safety & Mission Assurance
2100 Space Park Drive
Mail Code HS-12
Houston, TX. 77058

Approved By:

Michael J. Massie
Manager
Boeing ISS Safety
2100 Space Park Drive
Mail Code HS-12
Houston, TX. 77058

Donald W. Totton
NASA/JSC ISS Safety & Mission Assurance/Program Risk
Mail Code OE
2101 NASA Road 1
Houston, TX. 77058

SAMPLE IEHA REPORT – CONTINUED

Table of Contents (DELETED from sample)

Acronyms and Abbreviations (DELETED from sample)

Executive Summary
This integrated hazard assessment has determined that the Flight 4A payload complement does not pose any unacceptable hazards to the ISS vehicle and/or crew. Identified potential hazards have been addressed and controls in place have been determined to be adequate.

An integrated hazard assessment has been performed on the payloads and associated hardware and operations on ISS Assembly Flight 4A (STS-97). A potential acoustic noise hazard exists only if the IMAX3D camera and the MACE II experiment operate simultaneously in Node 1. MACE II will be operated by the Expedition 1 crew (Flight 2R). Simultaneous operations would violate the MACE II acoustic exception approved by the Acoustic Working Group.

The integrated noise environment in Node 1 has been assessed with the MACE II payload and support systems personnel. The integrated noise environment is consistent with NASA/JSC Flight Rules and does not constitute a hearing damage risk to the crew.

All other hazards associated with the Flight 4A payloads have been addressed adequately and identified on the individual payload hazard reports.

Purpose
The on-orbit Integrated Experiment Hazard Analysis (IEHA) report satisfies the Boeing contract requirements to perform an integrated analysis to assure the ISS (modules and external accommodations operating with complement of payloads) complies with customer defined safety requirements. The analysis results shall be documented and presented to the Payload Safety Review Panel (PSRP) and ISS Program management. The PSRP-approved IEHA stage report supports the PSRP Chairman's signature on the Payload Safety Certificate which is used as evidence for both the NASA and Boeing ISS Safety & Mission Assurance (S&MA) Certificate of Flight Readiness (CoFR) statement signatures.

List of Payloads
ISS Payloads are manifested in SSP 54102-04A, Increment Definition and Requirements Document (IDRD) for Planning Period 2 (PP2), Annex 1: Station Manifest, Flight 4A, STS-97 and IDRD, PP2, Annex 1, Station Manifest, Flight 4A, Change Request 3899, dated 10/03/00. Payloads for flights 2R and 2P were obtained from the Payload Safety home page, http://wwwsrqa.jsc.nasa.gov/pce/.

EDU-SGK-01	Educational Seed Growth Kit – one
MACE II	Middeck Active Control Experiment – two.

Sprut (MBI-1)	Measures inter- and extra- cellular fluid levels
Cardio-LBNB (MBI-5)	Measures heart rate under Lower Body Negative Pressure
URAGAN (GFI-8)	Earth observation experiment

List of Government Furnished Equipment

IMAX3D	Large format movie camera.
ISS-HAM	Amateur radio experiment. Also called the Space Amateur Radio Experiment-III (SAREX III).

Topology

UNITY (Node 1) Module
- MACE II
- IMAX3D (For storage, moves from module-to-module for filming.)

ZARYA (FGB) Module
- ISS-HAM

ZVEZDA (Service Module) Module
- Sprut (MBI-1)
- Cardio-LBNB (MBI-5)
- URAGAN (GFI-8)
- EDU-SGK-01

SAMPLE IEHA VTL

The IEHA Verification Tracking Log (VTL) reports any Responsible Verification Organization (RVO) information that has not been incorporated into the IEHA Report submitted to the PSRP. VTL will report any or all of the following information:

A) Date for tardy RVO CoC submittal,
B) Any open work the RVO is required to perform,
C) Estimated date of completion (ECD),
D) Any impact the CoC may have on the completed IEHA Report Executive Summary,

ORGANIZATION	OPEN WORK	ESTIMATED DATE of COMPLETION	IMPACTS/NOTES
Boeing EME Group	None		
Boeing ECLS	None		
Boeing Environments Group	None		
Boeing ISS S&MA	IEHA-015, 2.1.2 An analysis will be performed to determine the cumulative egress/isolation time from the module will not exceed three minutes.	April 1, 2001 (L-2.5 weeks).	No problems anticipated. Normal work usually completed by L-6 weeks. Late manifest changes impacted normal workflow.
JSC/DO Mission Operations Directorate (POIC)	None		
JSC/OC5 Cargo Planning and Imagery	None		
JSC/OZ3 Payload Engineering & Integration	None		
JSC/SN Space and Life Sciences Directorate	None		

International Partner VTL as required per SSP 50417 IP Addendum.

ORGANIZATION	OPEN WORK	ESTIMATED DATE of COMPLETION	IMPACTS/NOTES
Canadian Space Agency (CSA)	N/A for 7A.1		
European Space Agency (ESA)	N/A for 7A.1		
Japanese Space Agency (NASDA)	N/A for 7A.1		
Russian Space Agency (RASA)	None		

Appendix D – IEHA Generic Hazard Reports

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IEHA NO: 001		DATE: 04/24/01
Module: US-LAB, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE: Premature / Inadvertent payload complement Operations	CATEGORY: CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:
Inadvertent Payload Operations lead to a hazardous condition.

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Safety Policy and Requirements
NSTS 1700.7B ISS Addendum
Paragraph 218 Payload commanding

SSP 57000 Pressurized Payloads IRD
Paragraph 3.3.5.1.2 Commanding
Paragraph 3.3.5.1.4 Safety Data

SSP 41000 System Specs for ISS
Paragraph 3.3.6.3 Computer based control of hazardous functions

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 Inadvertent commanding from payload MDM causes a hazardous condition	1.1 Internal software checks are provided in the payload MDM to preclude inadvertent commanding to other payloads	1.1.1 Verify the successful performance of a Payload MDM software Functional Quality Test prior to pre-flight integrated testing. 1.1.2 Perform pre-flight integrated payload software validation through PSIV to ensure that software checks are in place to preclude erroneous commanding.	1.1.1.1 JSC/OZ3 Payload Engineering and Integration 1.1.2.1 JSC/OZ3 Payload Engineering and Integration
2.0 Inadvertent payload operations caused by connecting payload to wrong power source.	2.1 Payload to ISS ICDs provided to preclude incorrect power connections.	2.1.1 Verify payload compliment complies with ICDs. 2.1.2 Review crew installation procedures for compliance with ICDs.	2.1.1.1 JSC/OZ3 Payload Engineering and Integration 2.1.2.1 JSC/DO Mission Operations Directorate
3.0 Payload is relocated to another module and its operation results in a hazardous condition.	3.1 Payload to ISS ICDs provided to preclude incorrect power connections.	3.1.1 Verify payload compliment complies with ICDs. 3.1.2 Review crew installation procedures for compliance with ICDs.	3.1.1.1 JSC/OZ3 Payload Engineering and Integration 3.1.2.1 JSC/DO Mission Operations Directorate

IEHA NO: 002		DATE: 04/24/01
Module:	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY: CATASTROPHIC ( ) CRITICAL ( )
Incompatible/Corrosive/Flammable Materials	

HAZARD DESCRIPTION:

RESERVED

APPLICABLE REQUIREMENTS:

RESERVED

Reserved

HAZARD CAUSE:	HAZARD CONTROL	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
RESERVED	***RESERVED***	***RESERVED***	***RESERVED***

IEHA NO: 003 sheet 1 of 3		DATE: 04/24/01
Module: US-LAB, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE: Payload Complement Degrades Critical ISS Function(s)	CATEGORY: CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:

Cumulative power and/or thermal and/or chemical usage or failures associated with an ISS payload complement degrades ISS functions during on-orbit operations

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Safety Policy and Requirements

NSTS 1700.7B ISS Addendum
Paragraph 213 Electrical Systems

SSP 41000 System Specs for ISS
Paragraph 3.3.6.6 Environmental Safety
Paragraph 3.3.6.8 Electrical Hazards

SSP 57000 Pressurized Payloads IRD
Paragraph 3.5 Thermal Control Interface Requirements
Paragraph 3.9 Environmental Interface Requirements
Paragraph 3.12.9.1 Electrical Hazards

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 Cumulative power consumption by payload complement degrades ISS Electrical Power System capability (EPS).	1.1 Payload complement operations are constrained to preclude exceeding ISS EPS power consumption allocations.	1.1.1 Perform channelized power consumption analysis.	1.1.1.1 JSC/OZ3 Payload Engineering and Integration
		1.1.2 Document constraints to ensure adequate payload restrictions.	1.1.2.1 JSC/OZ3 Payload Engineering and Integration
		1.1.3 Review payload operating procedures to assure no conflict of operations with the ISS or other payloads results in an inadvertent or premature hazardous event.	1.1.3.1 JSC/DO Mission Operations Directorate

IEHA NO: 003 sheet 2 of 3		DATE: 04/24/01
Module: US-LAB, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE: Payload Complement Degrades Critical ISS Function(s)	CATEGORY: CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:

Cumulative power and/or thermal and/or chemical usage or failures associated with an ISS payload complement degrades ISS functions during on-orbit operations

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
		1.1.4 Review and verify completion of integrated payload crew training.	1.1.4.1 JSC/DO MOD (POIC)
		1.1.5 Coordination of hazard control implementation between MOD and OZ3.	1.1.5.1 JSC/DO MOD (POIC)
	1.2 Payload complement power consumption does not inhibit CO2 removal within the USOS and non-Russian international elements.	1.2.1 Perform channelized power consumption analysis on CO2 removal system.	1.2.1.1 JSC/OZ3 Payload Engineering and Integration
		1.2.2 Document constraints to ensure adequate payload restrictions.	1.2.2.1 JSC/OZ3 Payload Engineering and Integration
2.0 Cumulative thermal usage by payload complement degrades ISS Thermal Control System capability.	2.1 Payload operations are constrained to preclude exceeding ISS Thermal Control System thermal allocations.	2.1.1 Perform integrated thermal analysis.	2.1.1.1 JSC/OZ3 Payload Engineering and Integration
		2.1.2 Document constraints to ensure adequate payload restrictions.	2.1.2.1 JSC/OZ3 Payload Engineering and Integration
		2.1.3 Review payload operating procedures to assure no conflict of operations with the ISS or other payloads results in an inadvertent or premature hazardous event.	2.1.3.1 JSC/DO MOD (POIC)

IEHA NO: 003 sheet 3 of 3		DATE: 04/24/01
Module: US-LAB, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE: Payload Complement Degrades Critical ISS Function(s)	CATEGORY: CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:

Cumulative power and/or thermal and/or chemical usage or failures associated with an ISS payload complement degrades ISS functions during on-orbit operations

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
		2.1.4 Review and verify completion of integrated payload crew training.	2.1.4.1 JSC/DO Mission Operations Directorate (POIC)
		2.1.5 Coordination of hazard control implementation between MOD and OZ3.	2.1.5.1 JSC/DO Mission Operations Directorate (POIC)
3.0 Cumulative amounts of chemical emissions by the payload complement degrade ISS Environmental Control and Life Support System capability.	3.1 Payload operations are constrained to preclude exceeding ISS Environmental Control and Life Support System Carbon Dioxide (CO2) removal capability.	3.1.1 Document constraints to ensure adequate payload restrictions.	3.1.1.1 JSC/OZ3 Payload Engineering and Integration
		3.1.2 Review payload operating procedures to assure no conflict of operations with the ISS ECLS system.	3.1.2.1 JSC/DO Mission Operations Directorate

IEHA NO: 004		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
Excessive Ionizing Radiation	CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:
The cumulative effects of ionizing radiation (radioactive) emissions from the on-orbit payload complement results in hazardous effects on the crew, ISS and/or the payload complement.

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Safety Policy and Requirements
NSTS 1700.7B ISS Addendum
Paragraph 212.1 Ionizing Radiation

SSP 57000 Pressurized Payloads IRD
Paragraph 3.9.3 Radiation Requirements

SSP 41000 System Specs for ISS
Paragraph 3.3.10.4 Ionizing Radiation Emission Limits

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 Cumulative ionizing radiation from payload complement creates a hazardous condition to the crewmembers.	1.1 Cumulative ionizing radiation levels are limited to prevent a hazardous condition to the crewmembers.	1.1.1 Perform cumulative effect analysis of hazardous condition to the crewmembers due to payload ionizing radiation and identify payload constraints (if any).	1.1.1.1 JSC/SN Space and Life Sciences Directorate
2.0 Ionizing radiation emissions from payload complement creates a hazardous condition to the ISS.	2.1 Ionizing radiation emission levels are limited to prevent a hazardous condition to the ISS.	2.1.1 Analyze impact of payload ionizing radiation emissions on ISS and identify payload constraints (if any).	2.1.1.1 Boeing Environments Group
3.0 Ionizing radiation emissions from payload complement creates a hazardous condition to the payload complement.	3.1 Ionizing radiation emission levels are limited to prevent a hazardous condition to the payload complement.	3.1.1 Analyze impact of payload ionizing radiation emissions on the payload complement and identify payload constraints (if any).	3.1.1.1 Boeing Environments Group

IEHA NO: 005		DATE: 04/24/01
Module:	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
Excessive Non-Ionizing Radiation	CATASTROPHIC ( ) CRITICAL ( )

HAZARD DESCRIPTION:

RESERVED

APPLICABLE REQUIREMENTS:

RESERVED

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
RESERVED	***RESERVED***	***RESERVED***	***RESERVED***

IEHA NO: 006		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
EMI/EMC	CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:
Integrated payload complement circuitry emits excessive EMI (radiated and/or conductive) or the payload complement itself is susceptible to its surrounding EMI environment.

APPLICABLE REQUIREMENTS:	
NSTS 1700.7B Safety Policy and Requirements NSTS 1700.7B ISS Addendum Paragraph 212.2 Electromagnetic Emissions and susceptibility	SSP 41000 System Specs for ISS Paragraph 3.3.6.6 Environmental Safety SSP 57000 Pressurized Payloads IRD Paragraph 3.9.3 Radiation Requirements

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 Excessive electromagnetic conducted or radiated emissions from payload complement operation	1.1 Payload circuits are designed such that conducted emissions/transients are within limits specified limits	1.1.1 Perform a systems-level conductive emissions evaluation of component test data.	1.1.1.1 Boeing EME AIT
	1.2 Payload circuits are designed such that radiated emissions are below allowable susceptibility limits for other electrical or electronic equipment.	1.2.1 Perform a systems-level radiated emissions evaluation of component test data.	1.2.1.1 Boeing EME AIT
2.0 Payload complement is susceptible to ISS or other payload component produced EMI	2.1 Payload circuits are designed such that they are not susceptible to the payloads expected EMI environment	2.1.1 An evaluation of component level test data is performed to demonstrate payload circuit compatibility with the EMI environment.	2.1.1.1 Boeing EME AIT
3.0 The ISS vehicle is susceptible to payload complement produced EMI	3.1 The ISS vehicle is designed such that it is not susceptible to the payloads' emissions.	3.1.1 An evaluation of component level test data is performed to demonstrate ISS circuit compatibility with the EMI environment.	3.1.1.1 Boeing EME AIT

IEHA NO: 007		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
Structural Damage/Failure	CATASTROPHIC ( ) CRITICAL ( )

HAZARD DESCRIPTION:

RESERVED

APPLICABLE REQUIREMENTS:

RESERVED

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
RESERVED	*RESERVED*	*RESERVED*	*RESERVED*

IEHA NO: 008		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY: CATASTROPHIC ( ) CRITICAL ( )
External Collision/Contact Hazards	

HAZARD DESCRIPTION:

RESERVED

APPLICABLE REQUIREMENTS:

RESERVED

Reserved

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
RESERVED	***RESERVED***	***RESERVED***	***RESERVED***

IEHA NO: 009		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:
Hazardous EVA Operations Associated with External ISS Experiments

CATEGORY:
CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:
Hazardous EVA on-orbit operations.

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Safety Policy and Requirements
NSTS 1700.7B ISS Addendum
Paragraph 101.2 Flight Rules
Paragraph 215.1 Hazard Identification
Paragraph 217 Extravehicular Activity (EVA)

SSP 50021 Safety Requirements Document: ISS Program
Paragraph 1.2.2 Mission Rules
Paragraph 1.4.1 Delegation of Authority: ISS
Paragraph 3.3.6.12 Human Engineering Safety

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 See note.	1.1 See note.	1.1.1 Verify compliance with EVA safety requirements per MOD EVA safety process letter, DF4/91-43.	1.1.1.1 JSC/DO Mission Operations Directorate

NOTE: JSC Mission Operations Directorate (MOD) has accepted responsibility for all causes, controls and verification tasks as established by the PSRP. The EVA safety requirements include requirements for (1) touch temperatures, (2) equipment handling, (3) levers, cranks, hooks, and controls, (4) translation paths and worksites, (5) structural limits, (6) quick disconnects, and (7) any payload hazards outside the crew habitable area.

IEHA NO: 010		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
Cumulative Effects of Thermal Extremes (Reserved)	CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:

RESERVED

APPLICABLE REQUIREMENTS:

RESERVED

Reserved

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
RESERVED	***RESERVED***	***RESERVED***	***RESERVED***

IEHA NO: 011		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:

Nominal Operational Incompatibility

CATEGORY: CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:

Nominal operational incompatibilities between payload complement and/or the ISS result in hazardous condition.

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Payload Safety Requirements

NSTS 1700.7B ISS Addendum
Paragraph 215 Hazardous Operations

SSP 57000 Pressurized Payloads IRD
Paragraph 3.1.1.7 On-orbit Payload Protrusions
Paragraph 3.9.12 Crew Safety

SSP 41000 System Specs for ISS
Paragraph 3.3.6.12.2 IVA Crew and equipment safety

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 Payload complement/ISS operational procedures conflict with each other creating a hazardous condition to the crew/payload complement and/or the ISS.	1.1 Critical mission sequences and flight specific flight rules are developed to preclude any conflict or operations between payloads and the ISS.	1.1.1 ISS and payload complement operational procedures are assessed to assure no conflicts of operations can lead to a hazardous condition to the ISS and the crew. 1.1.2 ISS and payload complement operational flight rules are assessed to assure no conflicts of operations can lead to a hazardous condition to the ISS and the crew.	1.1.1.1 JSC/DO Mission Operations Directorate (POIC) 1.1.2.1 JSC/DO Mission Operations Directorate (POIC)
2.0 Crew procedures and/or flight rules are inconsistent with hazard controls defined in the payload hazard reports creating a hazardous condition to the crew and/or the ISS.	2.1 An independent operational hazard controls safety verification report ensures that the required hazard controls are incorporated into the proper procedures or flight rules.	2.1.1 Review operational procedures to assure incorporation of payload-required operational hazard controls as specified in the payload(s) hazard reports. 2.1.2 Review operational flight rules to assure incorporation of payload-required operational hazard controls as specified in the payload(s) hazard reports.	2.1.1.1 JSC/DO Mission Operations Directorate (POIC) 2.1.2.1 JSC/DO Mission Operations Directorate (POIC)

IEHA NO: 012		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
Structural Damage to Payloads	CATASTROPHIC ( ) CRITICAL ( )

HAZARD DESCRIPTION:

RESERVED

APPLICABLE REQUIREMENTS:

RESERVED

Reserved

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
RESERVED	***RESERVED***	***RESERVED***	***RESERVED***

IEHA NO: 013		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
Safety Critical Functions Fail to Operate	CATASTROPHIC ( ) CRITICAL ( )

HAZARD DESCRIPTION:

RESERVED

APPLICABLE REQUIREMENTS:

RESERVED

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
RESERVED	*RESERVED*	*RESERVED*	*RESERVED*

IEHA NO: 014		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:

IVA/Internal Operations

CATEGORY: **CATASTROPHIC (X) CRITICAL ( )**

HAZARD DESCRIPTION:

IVA/Internal Operations results in hazardous condition.

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Payload Safety Requirements
NSTS 1700.7B ISS Addendum
Paragraph 101.2 Flight Rules
Paragraph 102.2 Payload Safety Review Panel (PSRP) and Ground Safety Review Panel (GSRP)
Paragraph 215 Hazardous Operations

SSP 50021 Safety Requirements Document: ISS
Paragraph 1.2.2 Mission Rules
Paragraph 1.4.1 Delegation of Authority: ISS

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 Inadequate or incompatible procedures, IVA training, IVA tools, or both.	1.1 IVA work sites, interfaces and procedures were tested and checked out at JSC with flight hardware and training mockups. The flight crew was specifically trained for safety critical IVA scenarios documented in payload hazard reports.	1.1.1 Review appropriate crew procedures to ensure that no hazardous condition(s) are created for the IVA crewmembers. 1.1.2 Review and verify completion of integrated payload training to ensure crew is properly trained to perform safety critical functions.	1.1.1.1 JSC/DO Mission Operations Directorate (POIC) 1.1.1.2 JSC/DO Mission Operations Directorate (POIC)

IEHA NO: 015 sheet 1 of 2		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
Rapid Safing	CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:

Inability to perform rapid safing.

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Payload Safety Requirements
NSTS 1700.7B ISS Addendum
Paragraph 205 Contingency Return and Rapid Safing

SSP 41000 System Specs for ISS
Paragraph 3.3.6.11 Emergency Egress/Ingress

SSP 57000, Pressurized Payloads IDR
Paragraph 3.12.9.12 Egress

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 Inability to egress to adjacent module and close the hatch (isolation).	1.1 Payload configuration deployments and operational capabilities are constrained to ensure that emergency egress paths are maintained at all times.	1.1.1 An integrated worst-case configuration payload compatibility analysis is performed.	1.1.1.1 JSC/OZ3 Payload Engineering and Integration
		1.1.2 Constraints are developed and documented to preclude hazardous payload configurations.	1.1.2.1 JSC/OZ3 Payload Engineering and Integration
		1.1.3 Review payload operating procedures to assure no conflict of operations with the ISS or other payloads results in an inadvertent or premature hazardous event.	1.1.3.1 JSC/DO Mission Operations Directorate (POIC)

IEHA NO: 015 sheet 2 of 2			DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic		**Increment/Stage:** All
HAZARD TITLE: Rapid Safing		**CATEGORY:** **CATASTROPHIC (X) CRITICAL ( )**	
HAZARD DESCRIPTION: Inability to perform rapid safing.			
HAZARD CAUSE:	**HAZARD CONTROL:**	**VERIFICATION TASK**	**RESPONSIBLE VERIFICATION ORGANIZATION**
2.0 Emergency egress impeded by payload due to cables across hatch.	2.1 Payload design provisions combined with module configurations will allow crew egress/isolation.	2.1.1 Assessment of payload design to determine if crew response is needed for emergency egress/isolation (e.g. cables across hatches). 2.1.2 An analysis will be performed to determine that the cumulative egress/ isolation time of the module and the payload contribution will not exceed three minutes.	2.1.1.1 JSC/OZ3 Payload Engineering and Integration 2.1.2.1 Boeing ISS S&MA

IEHA NO: 016		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:	CATEGORY:
Hazardous accumulation of acoustic noise	CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:

On-orbit crew exposure to excessive noise results in crew injury.

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Payload Safety Requirements
NSTS 1700.7B ISS Addendum
No requirements

SSP 41000 System Specs for ISS
Paragraph 3.3.10.2 Acoustic Emission Limits

SSP 57000 Pressurized Payloads ird
Paragraph 3.12.3.3 Acoustic Requirements

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 Ambient cumulative and individual intermittent noise exceeds safe noise requirement allocation.	1.1 Payload racks or aisle mounted payloads are selected to be compatible with acoustic noise requirements.	1.1.1 A test of payload racks or aisle mounted payloads is performed to verify compatibility with acoustic noise requirements.	1.1.1.1 JSC/OZ3 Payload Engineering and Integration
	1.2 A payload complement will not be allowed to operate above the continuous noise limit constraints and/or the payload allocated intermittent noise limit constraints	1.2.1 An assessment is performed to verify that the payload complement is in compliance with the continuous and payload rack intermittent noise limit requirements.	1.2.1.1 JSC/OZ3 Payload Engineering and Integration

IEHA NO: 017		DATE: 04/24/01
Module: US-Lab, P6, Z1, Node 1	**Payload Complement:** Generic	**Increment/Stage:** All

HAZARD TITLE:

Inadequate/Inappropriate Stowage

CATEGORY: CATASTROPHIC (X) CRITICAL ( )

HAZARD DESCRIPTION:

Inadequate/Inappropriate stowage provisions (improperly stowed equipment) results in hazardous condition.

APPLICABLE REQUIREMENTS:

NSTS 1700.7B Payload Safety Requirements
NSTS 1700.7B ISS Addendum
Paragraph 215.3 Access

SSP 41000 System Specs for ISS
Paragraph 3.3.6.12.2 IVA Crew and equipment safety

SSP 57000 Pressurized Payloads IRD
Paragraph 3.9.12 Crew Safety

Boeing hazard report ISS-STO-0801

HAZARD CAUSE:	HAZARD CONTROL:	VERIFICATION TASK	RESPONSIBLE VERIFICATION ORGANIZATION
1.0 See note 1.	1.1 See note 1.	1.1.1 Signed ISS-STO-801 hazard report.	1.1.1.1 JSC/OC5 Cargo Planning and Imagery
2.0 See note 2.	2.1 See note 2.	2.1.1 Stowage provisions comply with payload operating procedures and flight rules.	2.1.1.1 JSC/DO Mission Operations Directorate (POIC)

NOTE: 1) Boeing ISS hazard report ISS-STO-801, Injury of Crew or Damage to ISS during Transfer and Stowage of Loose Hardware addresses stowage hazards more thoroughly as it accounts for all stowed items, vehicle hardware, GFE, and payloads. It includes causes for the following items. (1) Stowed hardware interferes with operation of critical systems. (2) Stowed hardware interferes with the ability to egress and isolate a module within 3 minutes. (3) Injury to crew during translation of manifested logistics and cargo items, and (4) Hardware stowage configuration exceeds physical limitations of interfering hardware and/or presents hazard to crewmember. JSC ISS Cargo Planning and Imagery is responsible for verifying the ISS stowage plan complies with ISS-STO-801.

2) JSC Mission Operations Directorate is responsible for reviewing payload operating procedures and flight rules verifying the stowage provisions and constraints are documented and comply with flight rules.

APPENDIX E – VERIFICATION TASK MATRIX

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VERIFICATION TASK MATRIX

RVO	Hazard Number	Verification Number and Task
Boeing Environments Group	IEHA-004	2.1.1 Analyze impact of payload ionizing radiation emissions on ISS and identify payload constraints (if any). 3.1.1 Analyze impact of payload ionizing radiation emissions on the payload complement and identify payload constraints (if any).
Boeing EME AIT	IEHA-006	1.1.1 Perform a systems-level conductive emissions evaluation of component test data. 1.2.1 Perform a systems-level radiated emissions evaluation of component test data. 2.1.1 An evaluation of component level test data is performed to demonstrate payload circuit compatibility with the EMI environment. 3.1.1 An evaluation of component level test data is performed to demonstrate ISS circuit compatibility with the EMI environment.
Boeing ISS S&MA	IEHA-015	2.1.2 An analysis will be performed to determine that the cumulative egress/ isolation time of the module and the payload contribution will not exceed three minutes.
JSC/DO	IEHA-001	2.1.2 Review crew installation procedures for compliance with ICDs. 3.1.2 Review crew installation procedures for compliance with ICDs.
JSC/DO (POIC) (POIC) (POIC) (POIC) (POIC)	IEHA-003	1.1.3 Review payload operating procedures to assure no conflict of operations with the ISS or other payloads results in an inadvertent or premature hazardous event. 1.1.4 Review and verify completion of integrated payload crew training. 1.1.5 Coordination of hazard control implementation between MOD and OZ3. 2.1.3 Review payload operating procedures to assure no conflict of operations with the ISS or other payloads results in an inadvertent or premature hazardous event. 2.1.4 Review and verify completion of integrated payload crew training. 2.1.5 Coordination of hazard control implementation between MOD and OZ3. 3.1.2 Review payload operating procedures to assure no conflict of operations with the ISS ECLS system.

RVO	Hazard Number	Verification Number and Task
JSC/DO	IEHA-009	1.1.1 Verify compliance with EVA safety requirements per MOD EVA safety process letter, DF4/91-43.
JSC/DO (POIC) (POIC) (POIC) (POIC)	IEHA-011	1.1.1 ISS and payload complement operational procedures are assessed to assure no conflicts of operations can lead to a hazardous condition to the ISS and the crew. 1.1.2 ISS and payload complement operational flight rules are assessed to assure no conflicts of operations can lead to a hazardous condition to the ISS and the crew. 2.1.1 Review operational procedures to assure incorporation of payload-required operational hazard controls as specified in the payload(s) hazard reports. 2.1.2 Review operational flight rules to assure incorporation of payload-required operational hazard controls as specified in the payload(s) hazard reports.
JSC/DO (POIC) (POIC)	IEHA-014	1.1.1 Review appropriate crew procedures to ensure that no hazardous condition(s) are created for the IVA crewmembers. 1.1.2 Review and verify completion of integrated payload training to ensure crew is properly trained to perform safety critical functions.
JSC/DO (POIC)	IEHA-015	1.1.3 Review payload operating procedures to assure no conflict of operations with the ISS or other payloads results in an inadvertent or premature hazardous event.
JSC/DO (POIC)	IEHA-017	2.1.1 Stowage provisions comply with payload operating procedures and flight rules.
JSC/OC5	IEHA-017	1.1.1 Signed ISS-STO-801 hazard report.
JSC/OZ3	IEHA-001	1.1.1 Verify the successful performance of a Payload MDM software Functional Quality Test prior to pre-flight integrated testing. 1.1.2 Perform pre-flight integrated payload software validation through PSIV to ensure that software checks are in place to preclude erroneous commanding. 2.1.1 Verify payload compliment complies with ICDs. 3.1.1 Verify payload compliment complies with ICDs.
JSC/OZ3	IEHA-003	1.1.1 Perform channelized power consumption analysis. 1.1.2 Document constraints to ensure adequate payload restrictions. 1.2.1 Perform channelized power consumption analysis on CO2 removal system.

RVO	Hazard Number	Verification Number and Task
		1.2.2 Document constraints to ensure adequate payload restrictions. 2.1.1 Perform integrated thermal analysis. 2.1.2 Document constraints to ensure adequate payload restrictions. 3.1.1 Document constraints to ensure adequate payload restrictions.
JSC/OZ3	IEHA-015	1.1.1 An integrated worst-case configuration payload compatibility analysis is performed. 1.1.2 Constraints are developed and documented to preclude hazardous payload configurations. 2.1.1 Assessment of payload design to determine if crew response is needed for emergency egress/isolation (e.g. cables across hatches).
JSC/OZ3	IEHA-016	1.1.1 A test of payload racks or aisle mounted payloads is performed to verify compatibility with acoustic noise requirements. 1.2.1 An assessment is performed to verify that the payload complement is in compliance with the continuous and payload rack intermittent noise limit requirements.
JSC/SN	IEHA-004	1.1.1 Perform cumulative effect analysis of hazardous condition to the crewmembers due to payload ionizing radiation to identify payload constraints (if any).